Stock Assessment Program Review

Stock Assessment Research

Jim Berkson

NOAA FISHERIES

SEFSC

Overview

- Research benefits stock assessments.
- The SEFSC conducts outstanding research.
- Time for research isn’t sufficient.
- What are the obstacles?
- Can the obstacles be removed? If so, how?

Organization

- Benefits
- SEFSC Research
- Quantity
- Obstacles
- Solutions

Research at the SEFSC

- Examples throughout this talk
- Tangents to the story
- Important to show what we're doing

Organization

- ***Benefits***
- SEFSC Research
- Quantity
- Obstacles
- Solutions

Benefits

- Output more effective for guiding policy
- Incorporates more information
- Provides better estimates of uncertainty
- Moves away from single species assessments
- Lets scientists be scientists

Research Examples

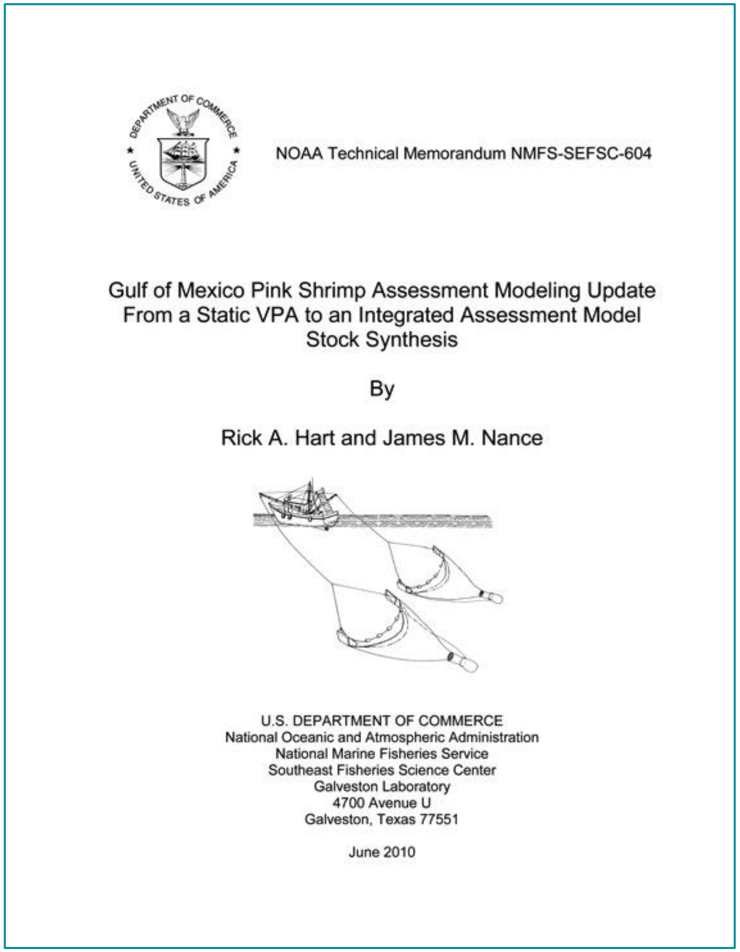
Examples – Stock assessment models

- ASPIC – Mike Prager
- VPA-2BOX – Clay Porch
- ASAP – Chris Legault & Victor Restrepo
- SSASPM – Clay Porch
- BAM – Erik Williams & Kyle Shertzer
- Gedamke – Hoenig (variations) – Todd Gedamke and Meaghan Bryan

Improving assessment methodologies

Moving from a static VPA to Stock Synthesis for Gulf of Mexico pink shrimp

Rick Hart and Jim Nance


NOAA Technical Memorandum NMFS-SEFSC-604

Gulf of Mexico Pink Shrimp Assessment Modeling Update
From a Static VPA to an Integrated Assessment Model
Stock Synthesis

By

Rick A. Hart and James M. Nance

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Improving assessment methodologies

Non-linear time series modeling to forecast short-term stock dynamics. *(current)*

Mandy Karnauskas

Organization

- Benefits
- ***SEFSC Research***
- Quantity
- Obstacles
- Solutions

SEFSC Research

- Highly applied (beneficial to current, ongoing assessments)
- Often done in the course of conducting assessments.
- Applicable to other stocks, assessments, and Science Centers (including international assessments)
- Product of the ingenuity and unique skills and experience of our scientists

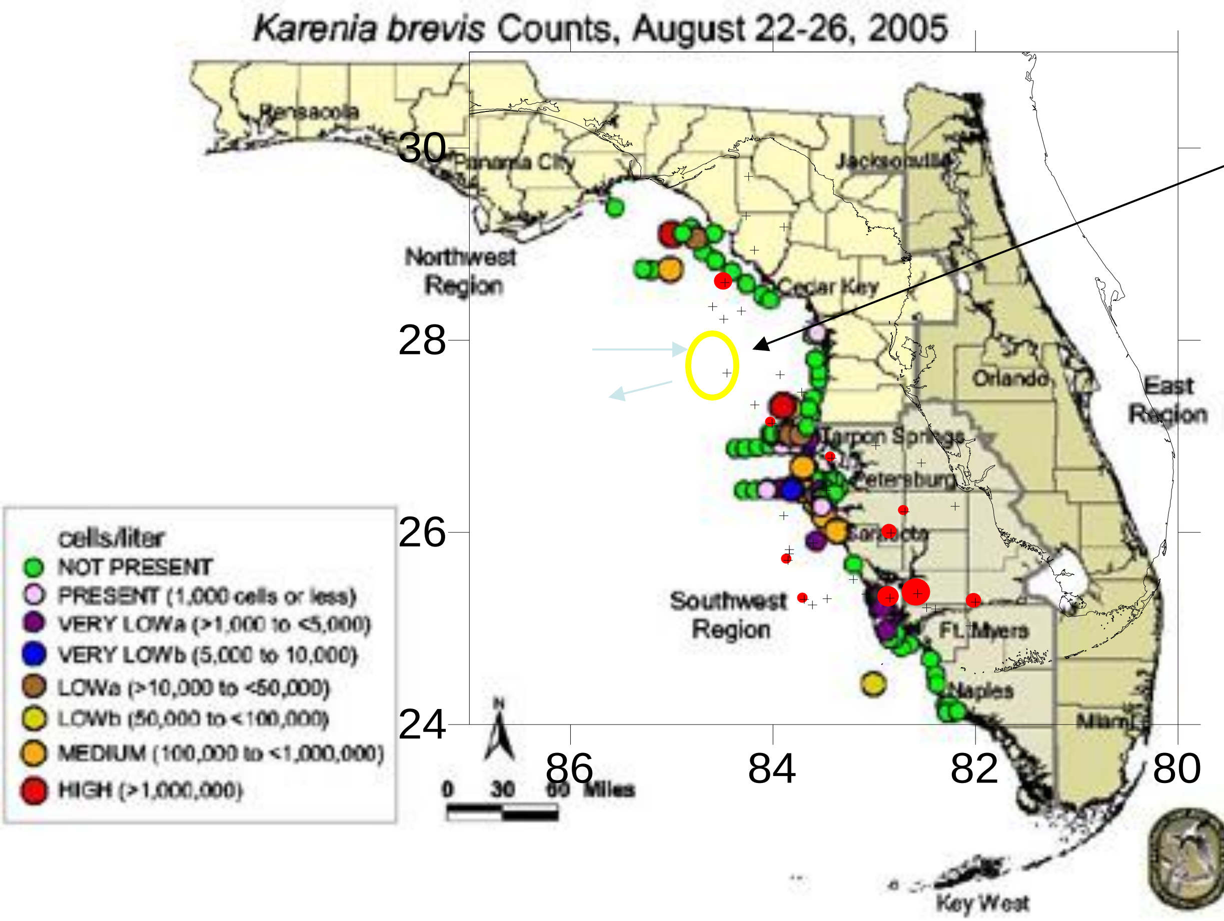
Research Examples

Example – Red tide and Gag grouper

Satellite derived indices of red tide severity for input for Gulf of Mexico Gag grouper stock assessment.

Walter, J. F., Christman, M. C., Landsberg, J., Linton, B., Steidinger, K., Stumpf, R., & Tustison, J. (2013). *SEDAR33-DW08. SEDAR, North Charleston, SC.*

NMFS survey in 2005 sampled during the red tide event. One station was very close to a very high in red tide measurement.

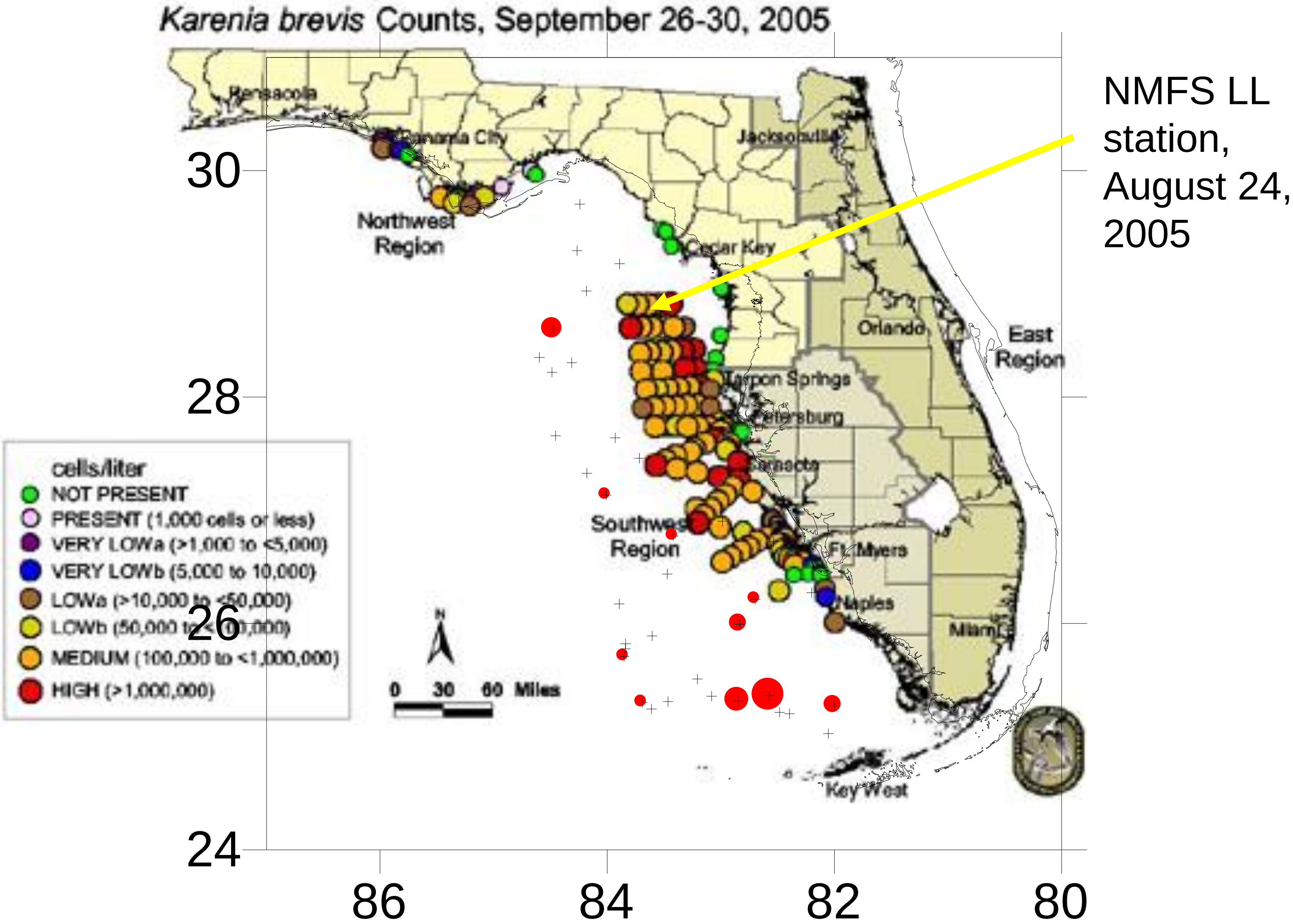


NMFS LL station, August 24, 2005 Station log

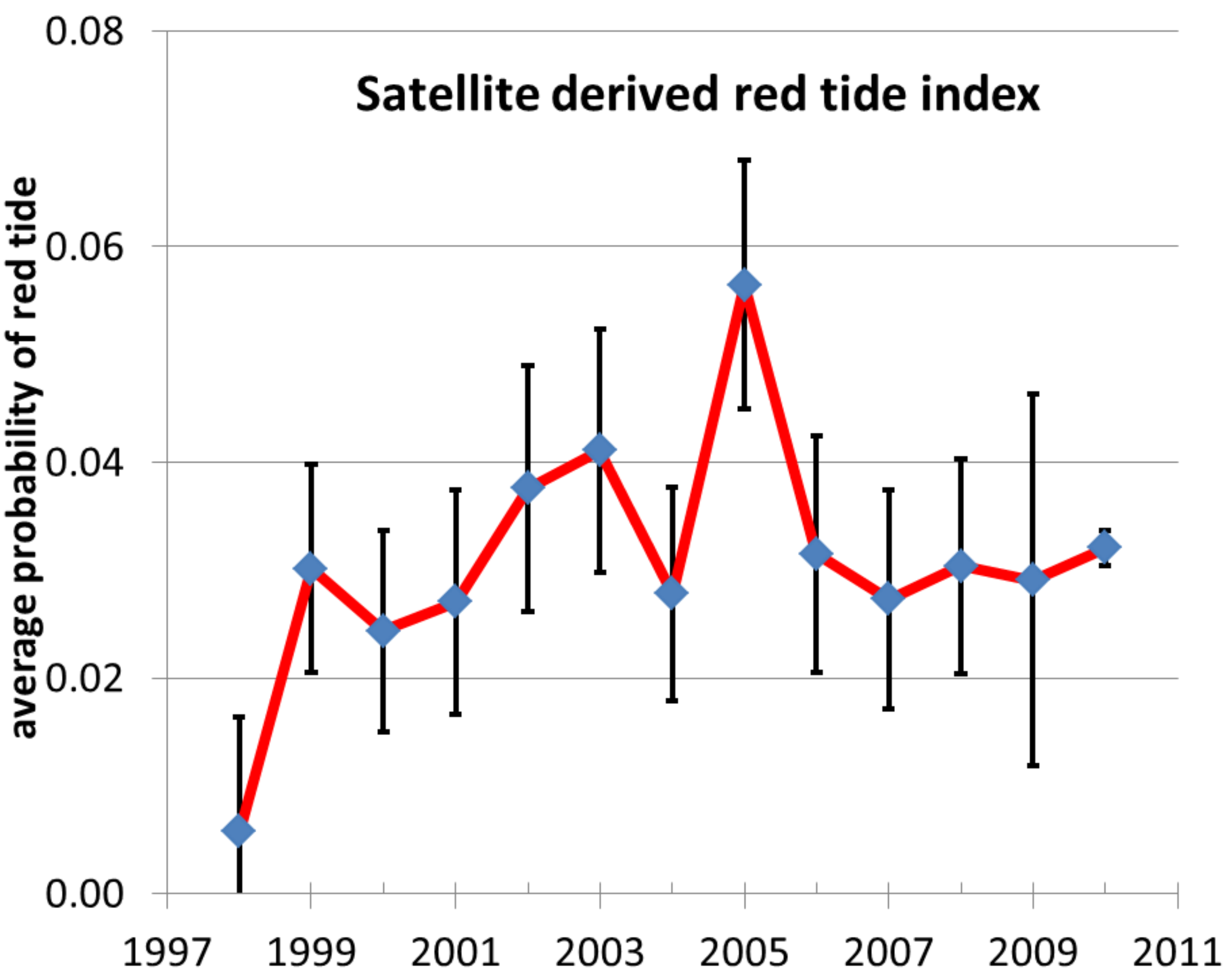
"4 or 5 dolphins (frontalis) close to ship at haul. During steam for 3 or so hours broad area of dead fish floating at surface, what looked like a 50 lb warsaw grouper spotted at haulback end."

DO on bottom: 0.1

By September red tide was everywhere sampling extended



Including the index greatly improves population modeling and explains what was otherwise unexplained declines (~20% of the population, or 8 million groupers (gag and red combined) in 2005



Walter et al 2013

Updating data and input

Developing a two-step fishery-independent design to estimate the relative abundance of deepwater reef fish: Application to a marine protected area off the southeastern United States coast.

Rudershausen, P.J., W.A. Mitchell, J.A. Buckel, E.H. Williams, and E. Hazen. 2010. Fish Res 105:254-260.

Fisheries Research 105 (2010) 254–260

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journal homepage: www.elsevier.com/locate/fishres

Short communication

Developing a two-step fishery-independent design to estimate the relative abundance of deepwater reef fish: Application to a marine protected area off the southeastern United States coast

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ABSTRACT

Reliable data on reef fishes inhabiting the southeastern United States (North Carolina to Florida) continental shelf large marine ecosystem are difficult to obtain; catch quotas and time and area closures limit the collection of fishery-dependent samples. Further, unbiased fishery-independent samples are expensive to collect with conventional fishing gear. Consequently, stock assessments are often data-limited, especially for deepwater reef species. We estimated the relative abundance of deepwater reef fish with a double sampling approach using fisheries acoustics and conventional fishing gear (hook and line and chevron traps). Double sampling occurred within the newly-created Snowy Wreck Marine Protected Area and a nearby control site. Reef fish concentrations were identified by a single-beam Simrad ES60 transceiver with a transducer operating at 38 kHz. Hook and line samples were collected at 73 acoustic events, and chevron trap samples were collected at 20 acoustic events. The relationship between fisheries acoustic data and catch-per-unit-effort (CPUE) data was examined to develop a model to predict species-generic CPUE at unfished locations. Akaike's Information Criteria (AIC) found equal support for linear, exponential, and power relationships between acoustic backscatter and CPUE for each conventional fishing gear. Further model development would be aided by refining acoustic target information and applying complimentary fish sampling gears (i.e., split-beam fisheries acoustics gear, underwater video). Given further development, a double sampling design should be useful to estimate the relative abundance of important deepwater reef species over a wide area of the shelf break off the southeastern United States, utilizing either survey vessels or vessels-of-opportunity to rapidly collect acoustic samples.

1. Introduction

Most deepwater (80–200 m) reef fishes inhabit hard-bottom habitat along the continental shelf break of the southeastern United States continental shelf large marine ecosystem (SUSLME; North Carolina to Florida). These species are difficult to assess. Intermittent commercial operations, multiple landing sites, variability of species targeted, and dynamic regulations hinder the collection of representative fishery-dependent information. Collection of unbiased fishery-independent information, such as catch-per-unit-effort (CPUE) data, is often cost-prohibitive; the Marine Resource Monitoring Assessment Program (MARMAP) is the only long-term, fishery-independent survey for deepwater reef species of the SUSLME, but occurs over only a fraction of the region, and only regularly from 16 to 91 m deep (McGovern et al., 1998). Estimates of abundance using conventional fishing gears are plagued by high variability (Hanselman and Quinn, 2004); this is especially challenging in the SUSLME because reef fish aggregations over hard-bottom habitat are patchily distributed.

The current stock status of many deepwater reef species in the SUSLME underscores the importance of developing new methods to estimate their abundance. The commercially-important deepwater reef species, snowy grouper (*Epinephelus niveatus*), is overfished and speckled hind (*Epinephelus drummondhayi*) and warsaw grouper (*Epinephelus nigritus*) are species of concern. Depleted or inherently low fish stock sizes hinder the ability to develop reliable indices of relative abundance (Ressler et al., 2009).

Development of effective approaches for sampling deepwater reef fish habitat is needed across a wider area of the continental shelf break of the SUSLME. Eight marine protected areas (MPAs) have recently been designated in the SUSLME. The intent

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doi:10.1016/j.fishres.2010.05.005

Exploring parameters (input and estimated)

Multi-species estimation of Bayesian priors for catchability trends and density dependence in the U.S. Gulf of Mexico.

Thorson, J, and J. Berkson. 2010. Canadian Journal of Fisheries and Aquatic Sciences 67:936-954.

Organization

- Benefits
- SEFSC Research
- ***Quantity***
- Obstacles
- Solutions

Quantity

- In FY13, 14 manuscripts were submitted by the 15 assessment leads.
- Less than one per assessment lead.

Quantity

Regarding current levels of research:

- Additional research would improve policy advice
- Levels below those expected by NMFS
- Levels below other NMFS Science Centers
- Insufficient to qualify for promotions
- Keeps scientists from being scientists
- Hinders ability of scientists to be “current”
- Lowers morale

Improved policy advice

A probability-based approach to setting annual catch levels.

Shertzer, K.W., M.H. Prager, and E.H. Williams. 2008. Fish Bull 106:225-232.

A probability-based approach to setting annual catch levels

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Abstract—The requirement of setting annual catch limits to prevent overfishing has been added to the Magnuson–Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSRA). Because this requirement is new, a body of applied scientific practice for deriving annual catch limits and accompanying targets does not yet exist. This article demonstrates an approach to setting levels of catch that is intended to keep the probability of future overfishing at a preset low level. The proposed framework is based on stochastic projection with uncertainty in population dynamics. The framework extends common projection methodology by including uncertainty in the limit reference point and in management implementation, and by making explicit the risk of overfishing that managers consider acceptable. The approach is illustrated with application to gag (*Mycteroperca microlepis*), a grouper that inhabits the waters off the southeastern United States. Although devised to satisfy new legislation of the MSRA, the framework has potential application to any fishery where the management goal is to limit the risk of overfishing by controlling catch.

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Manuscript accepted 15 February 2008.
Fish. Bull. 106:225–232 (2008).

The views and opinions expressed or implied in this article are those of the author and do not necessarily reflect the position of the National Marine Fisheries Service, NOAA.

The Magnuson–Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSRA) requires that each Fishery Management Plan in the United States "establish a mechanism for specifying annual catch limits … at a level such that overfishing does not occur in the fishery …" (MSRA, 2006). This requirement, which reflects an increased emphasis on conservation, is new in the sense that prevention of overfishing is mandated to be through annual catch limits (ACLs), rather than only through such less restrictive measures as trip limits, size limits, or days allowed at sea. Because the statute requires ACLs to be implemented by 2011 in all fisheries (by 2010 for fisheries where overfishing is occurring), discussion has begun on ways to compute them. Accompanying the discussion of ACLs is the discussion of corresponding annual catch targets (ACTs), levels of catch set as quotas in the fishery.

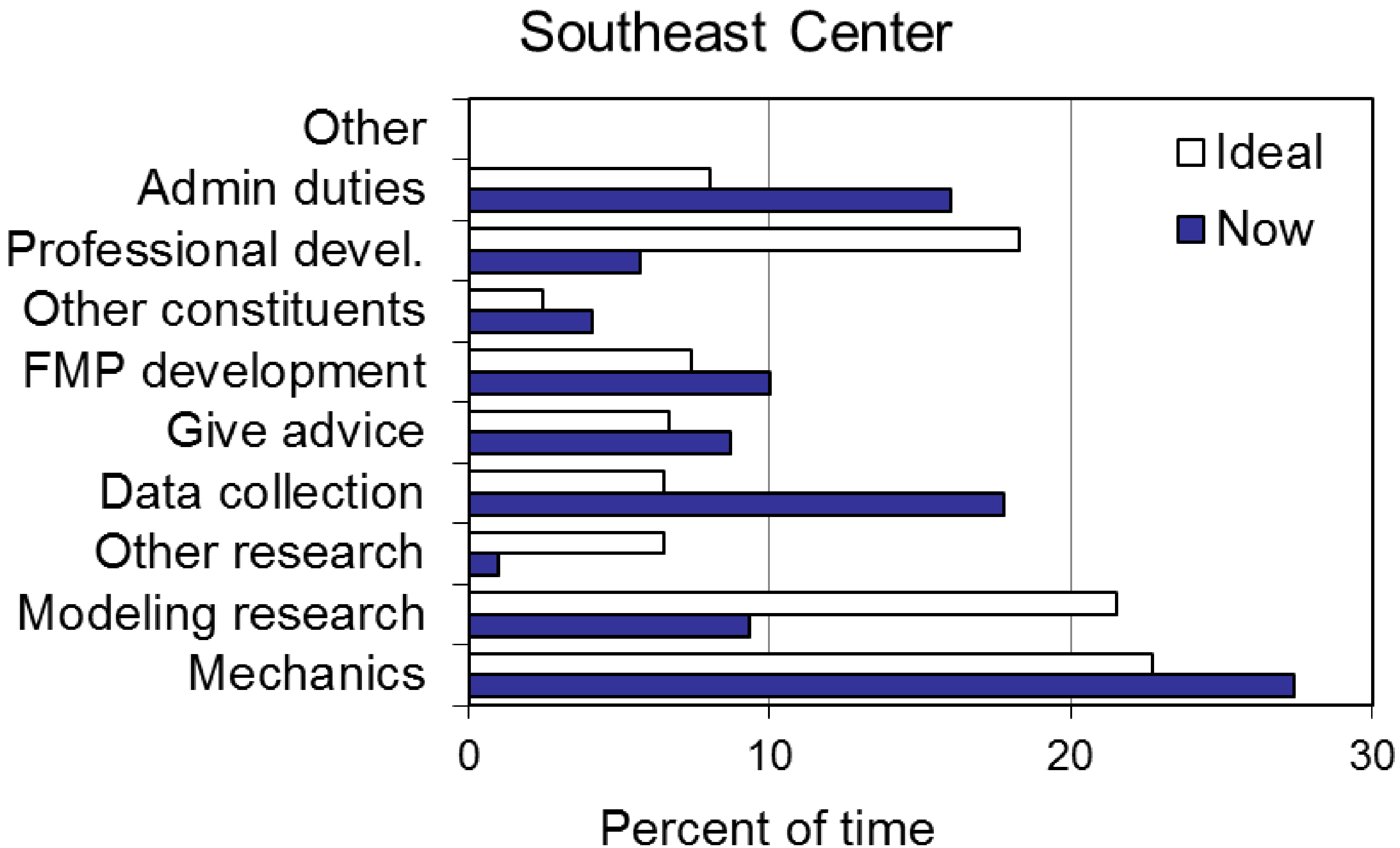
In this study, we propose a method for setting annual catch levels that are treated as targets, but equally well could serve as limits. The method is based on stochastic projection with uncertainty in population dynamics. It extends usual projection methodology by including uncertainty in the limit reference point and in management implementation, and by making explicit the overfishing risk that managers consider acceptable. This probabilistic approach was devised specifically to satisfy the U.S. statute, but we expect it should be useful whenever the management approach is to limit the risk of overfishing by controlling catch.

From a technical point of view, the requirement to set ACLs is interesting in that overfishing is defined in terms of a fishery input (i.e., fishing-induced mortality rate), yet the control mechanism is defined in terms of a fishery output (i.e., catch). (Review of inputs and outputs in fishery management can be found in Morison [2004] and Walters and Martell [2004].) Values connecting inputs and outputs mathematically are stock abundance and age structure, which change from year to year. Ideally, then, a method to set catch levels would take into account both uncertainty in the estimates of current stock abundance and structure and the expectation that abundance and structure will change with time. Current harvest-control rules for fisheries usually depend on a limit reference point, and uncertainty in estimating the limit reference point should also be considered. The limit reference point (typically the fishing rate at maximum sustainable yield (F_{MSY}) or a proxy for it) is generally considered to represent the level at which overfishing occurs (Mace, 2001).

Given the uncertainties in population dynamics, stock assessment, and fishery management, it is arguably impossible to fish without some risk of overfishing. Rather than attempting to achieve zero probability of overfishing, our approach avoids

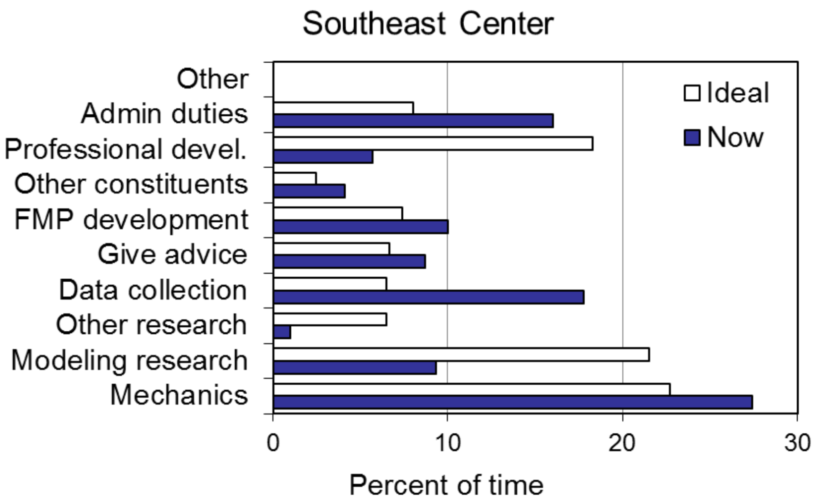
Levels below that expected by NMFS

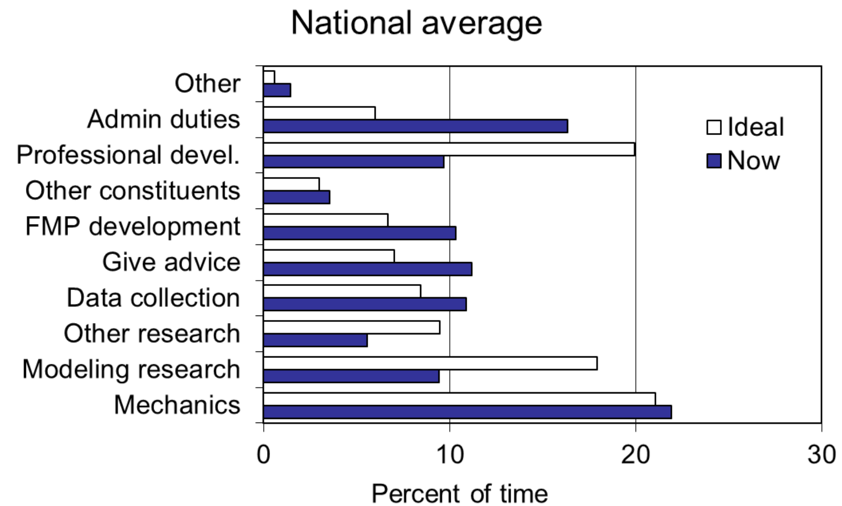
Time and Motion Analysis (NMFS Stock Assessment Improvement Plan, p. 43)



Levels below other NMFS Science Centers

Time and Motion Analysis (NMFS Stock Assessment Improvement Plan, p. 43)





% staff time	Southeast		National average	
Topic	**Actual**	**Ideal**	**Actual**	**Ideal**
Professional development	6	18	10	20
Research	10	28	15	27
Mechanics and administ.	43	31	38	27

Insufficient to qualify for promotions

"Primary authorship of a number of important publications including seminar or synthesis publications, some of which have had a major impact on advancing the field or are accepted as authoritative in the field"

Research Scientist Factor Level Guidance, Factor 4

Keeps scientists from being scientists

Research Fishery Biologist (ZP-III) performance plan

- 50% Stock assessment activities
- 40% Research and continuing education
- 10% Outreach

"Conduct research that advances fisheries science, making important changes to existing products, processes, techniques or practices. Publish significant findings in peer reviewed scientific journals and/or present at various professional organizations."

Hinders ability of scientists to be “current”

- Designing, conducting, and presenting cutting edge research is how scientists learn state-of-the-art science.

Staffing implications

- Assessment burnout
- Low morale
- Recruiting problems
- Retention problems

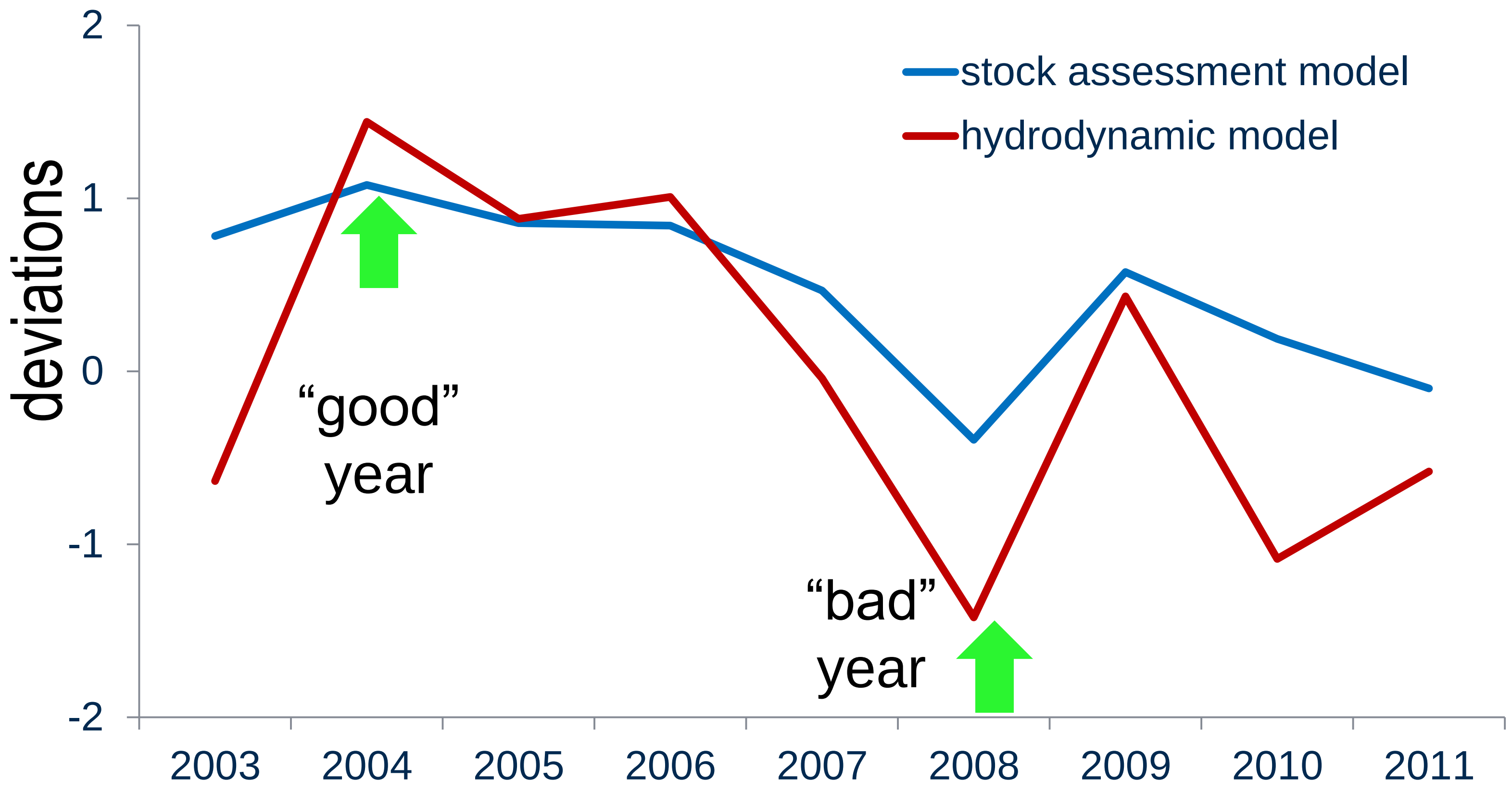
Research Examples

Incorporating environmental and habitat factors

Use of a biophysical modeling framework to model the process of recruitment and predict recruitment strength due to oceanographic factors. (*current*)

Mandy Karnauskas

Red snapper 2012 assessment

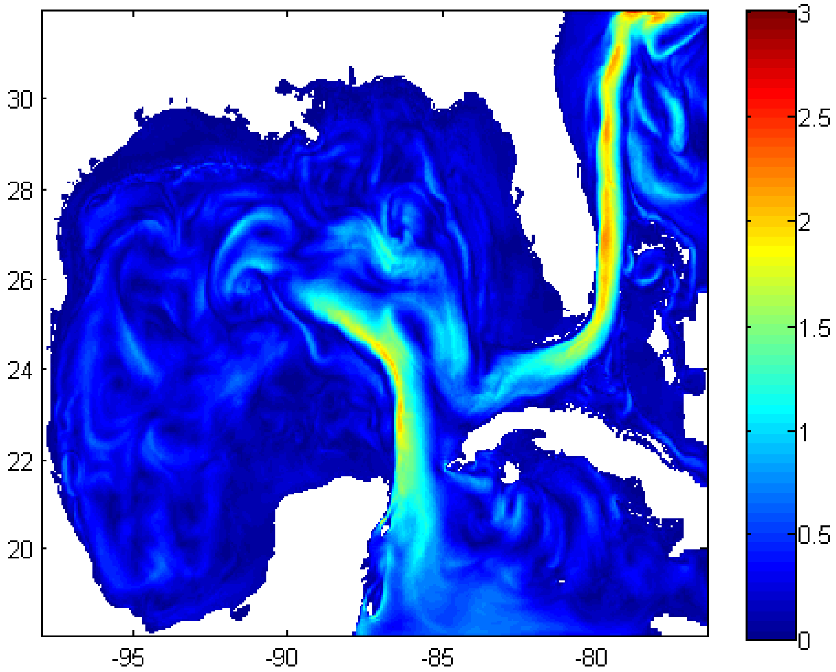


Karnauskas et al. 2013.

Oceanographic currents

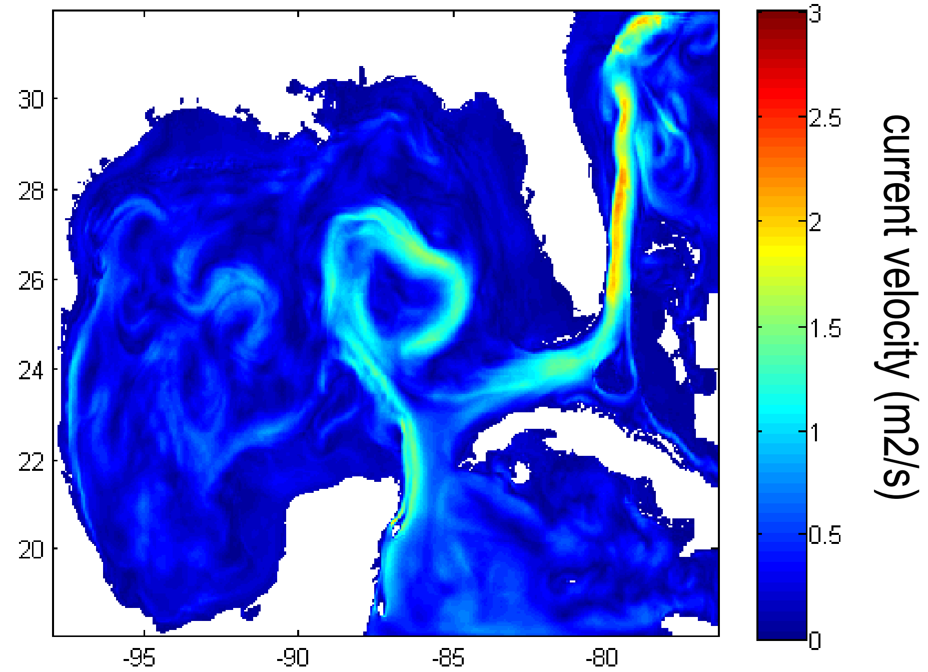
2008 – bad year

Larvae advected away from settlement areas

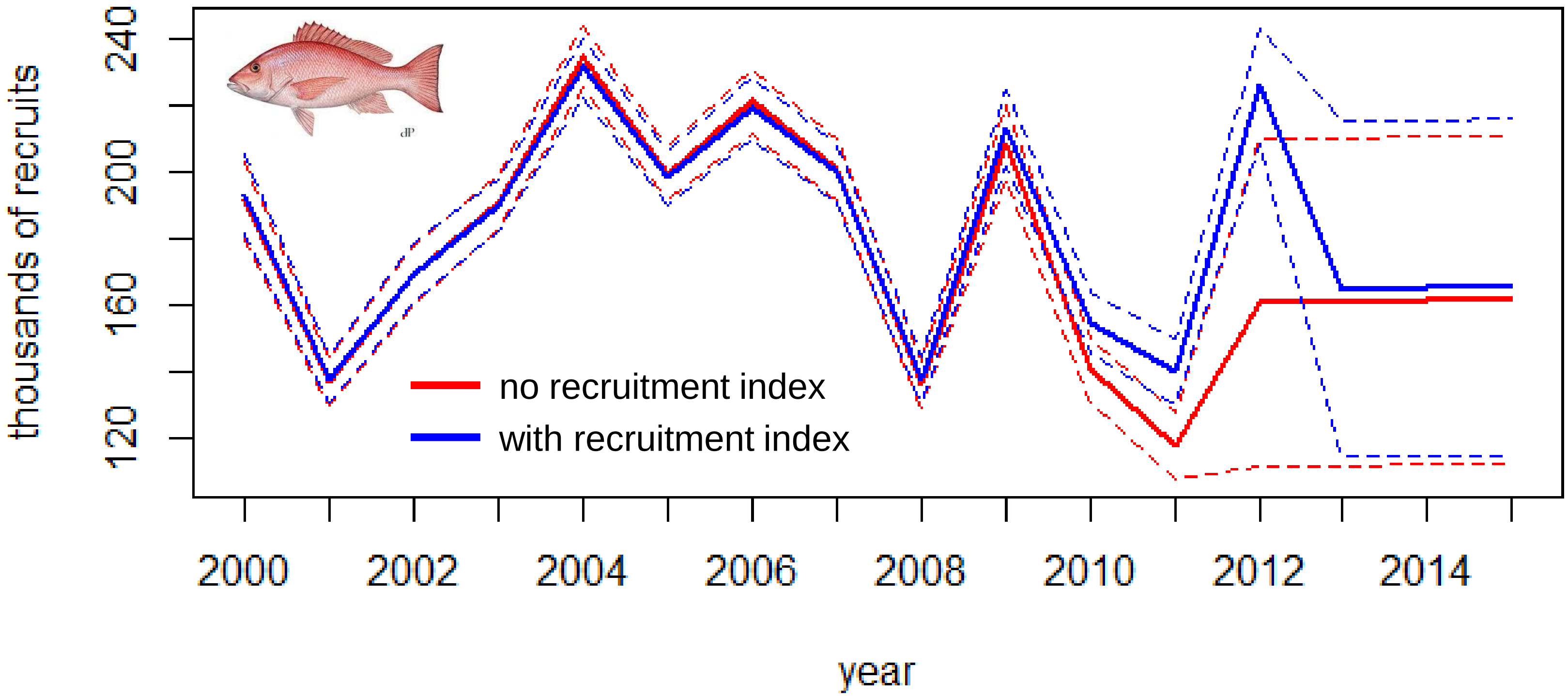


2012 – good year

Larvae advected towards settlement areas



Effect on stock assessment model



Investigating reference points, harvest control rules and management options

Ecological Risk Assessment of pelagic sharks caught in Atlantic pelagic longline fisheries.

Cortes et al. 2010. Aquat. Living Resources 23:25-34

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DOI: 10.1051/alr/2009044
www.alr-journal.org

Aquatic Living Resources
ICCAT CICTA CICAA

Ecological risk assessment of pelagic sharks caught in Atlantic pelagic longline fisheries

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Abstract – An ecological risk assessment (ERA; also known as productivity and susceptibility analysis, PSA) was conducted on eleven species of pelagic elasmobranchs (10 sharks and 1 ray) to assess their vulnerability to pelagic longline fisheries in the Atlantic Ocean. This was a level-3 quantitative assessment consisting of a risk analysis to evaluate the biological productivity of these species and a susceptibility analysis to assess their propensity to capture and mortality in pelagic longline fisheries. The risk analysis estimated productivity (intrinsic rate of increase, *r*) using a stochastic Leslie matrix approach that incorporated uncertainty in age at maturity, lifespan, age-specific natural mortality and fecundity. Susceptibility to the fishery was calculated as the product of four components, which were also calculated quantitatively: availability of the species to the fleet, encounterability of the gear given the species vertical distribution, gear selectivity and post-capture mortality. Information from observer programs by several ICCAT nations was used to derive fleet-specific susceptibility values. Results indicated that most species of pelagic sharks have low productivities and varying levels of susceptibility to pelagic longline gear. A number of species were grouped near the high-risk area of the productivity-susceptibility plot, particularly the silky (*Carcharhinus falciformis*), shortfin mako (*Isurus oxyrinchus*), and bigeye thresher (*Alopias superciliosus*) sharks. Other species, such as the oceanic whitetip (*Carcharhinus longimanus*) and longfin mako (*Isurus paucus*) sharks, are also highly vulnerable. The blue shark (*Prionace glauca*) has intermediate vulnerability, whereas the smooth hammerhead (*Sphyrna zygaena*), scalloped hammerhead (*Sphyrna lewini*), and porbeagle (*Lamna nasus*) sharks are less vulnerable, and the pelagic stingray (*Pteroplatytrygon violacea*) and common thresher (*Alopias vulpinus*) sharks have the lowest vulnerabilities. As a group, pelagic sharks are particularly vulnerable to pelagic longline fisheries mostly as a result of their limited productivity.

Key words: Ecological risk assessment / Leslie matrix / Shark life history / Vulnerability / Pelagic fisheries

Résumé – Une évaluation des risques écologiques (ERA) et/ou analyse de productivité – sensibilité/vulnérabilité (PSA), pour les pêcheries capturant plusieurs espèces, est mise en œuvre pour douze espèces d'Elasmobranches pélagiques (10 requins et une raie) afin d'estimer leur vulnérabilité à la pêche à la palangre en Atlantique. Trois approches d'évaluation quantitative consistant en une analyse de risque pour évaluer la productivité biologique de ces espèces, l'analyse de leur vulnérabilité à la capture et leur mortalité lors de ces pêches hauturières à la palangre. Les analyses de risques estiment la productivité (taux de croissance intrinsèque de la population, *r*) en utilisant une matrice stochastique de Leslie et en incorporant une incertitude au niveau de l'âge à la maturité sexuelle, la durée de vie, l'âge à la mortalité naturelle et la fécondité. La vulnérabilité à la pêche est calculée comme le produit de 4 composantes, qui sont également

[a] Corresponding author: Enric.Cortes@noaa.gov

Article published by EDP Sciences

Investigating reference points, harvest control rules and management options

Using a stock assessment framework to examine the switch to circle hooks: Exploring the effects of changes in catchability and selectivity, and implications for management.

Cass-Calay, S., J. Walter, and M. Schirripa. 2012. Bull Mar Sci 88:745-754.

Organization

- Benefits
- SEFSC Research
- Quantity
- ***Obstacles***
- Solutions

Obstacles

- Assessment load (mandates, process)
- Resources available (FTEs, time)

Organization

- Benefits
- SEFSC Research
- Quantity
- Obstacles
- ***Solutions***

Solutions –
How have we been dealing with the problem?

- Teaming with university faculty, post-docs and grad students
- Reducing our own productivity

Solutions

What other ways could we increase research productivity and give our stock assessment scientists more time to conduct research?

What would our stock assessments be like if we hadn’t completed the research presented today?

What could our stock assessments be like if we had the time expected of us to conduct research?

Review

- Research benefits stock assessments.
- The SEFSC conducts outstanding research.
- Research productivity is limited.
- What are the obstacles?
- Can the obstacles be removed? If so, how?

Questions?